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MODULAR SIMULATOR SYSTEM (MSS)

SYSTEM/SEGMENT SPECIFICATION FOR THE GENERIC MSS - SYSTEM INTEGRATION VOLUME 1

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AUGUST 1993

FINAL REPORT

SYSTEMS ENGINEERING DIVISION
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This technical report has been reviewed and is approved for publication.

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13. ABSTRACT *(Maximum 200 words)*

This is the System Integration portion of the generic Modular Simulator System (MSS) specification. It is designed to be tailored to specify the requirements for a specific aircraft training device or family of aircraft training devices. This specification contains specific tailoring instructions for each paragraph. When the tailoring process is complete, the italicized tailoring instructions should have been replaced by application specific text or deleted from the specification. It is suggested that the user read the "Modular Simulator Engineering Guide" and the "Modular Simulator Management Guide" prior to tailoring this volume.

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PREFACE

This generic Modular Simulator System (MSS) segment specification has been developed in accordance with DI-CMAN-80008A, Data Item Description for System/Segment Specifications. This specification meets or exceeds the requirements for MIL-STD-490, Type A, specifications. This specification is designed to be tailored to specify the requirements for a specific aircraft training device or family of aircraft training devices. Training devices may consist of Weapons System Trainers (WST), Operational Flight Trainers (OFT), Cockpit Procedures Trainers (CPT), Part Task trainers (PTT), etc.

Tailoring will be necessary to meet specific application requirements. The tailoring must be accomplished so as not to violate the goals and intent of the MSS concept. It is assumed that the user of this document has a familiarity with the MSS design concepts and architecture, the application aircraft training requirements, and general working knowledge of aircraft training systems. It is suggested that the user read the "Modular Simulator System Engineering Design Guide (D495-10440-1) and the "Modular Simulator System Management Guide" (D495-10439-1 prior to tailoring this specification. These guides provide an overview of the MSS architecture, an in-depth discussion on its application, and lessons learned from previous applications.

Each segment in the MSS architecture provides a portion of the overall system functionality. Similar functions and operations were grouped in each segment based on past experience, areas of design expertise, and management of intersegment communication. To promote reuse of the segments and gain the maximum benefits of using the MSS approach, it is suggested that the user adhere to the generic functional allocation. Interfaces between the segments should remain relatively constant from application to application. The application vehicle is considered to be an aircraft (e.g. fixed wing, variable geometry, or rotary wing), although the MSS architecture and concepts may be applied to either ground or sea vehicles.

This specification contains specific tailoring instructions for each paragraph. The instructions are contained within the paragraphs, and are identified by blank spaces and/or italicized text. When the tailoring process is complete, the italicized tailoring instructions should have been replaced by application specific text or deleted from the specification. Paragraphs which do not apply to a particular application should not be deleted. They should be identified as "Not Applicable" to maintain paragraph numbering consistency between volumes and various MSS applications.

1. SCOPE

1.1 Identification. This System Specification establishes the system level requirements for the _____ *(insert application aircraft type)* Modular Simulator System (MSS).

(An application aircraft unique identification statement should be added to this paragraph. The statement should unambiguously identify the system to be simulated along with it's identification number.)

1.2 System Overview. This specification establishes system requirements for the development and testing of a MSS representing the _____ *(insert application aircraft type)*. The MSS provides aircrew training in cockpit familiarization, flight characteristics, operating procedures, and mission procedures for the _____*(insert application aircraft type)* aircraft. The _____ *(insert application aircraft type)* MSS, will provide capabilities required to familiarize trainees with the cockpit configuration and flight characteristics of the _____*(insert application aircraft type)* aircraft. It will provide a training environment for executing mission procedures from pre-flight through post-flight including: engine start, taxi, takeoff, climb, cruise, aerial refueling, navigation, weapons delivery, damage assessment, and landing *(Specific training goals for the application aircraft should be listed.)*. The MSS will allow trainees to gain proficiency in executing normal and emergency procedures.

(This paragraph should be modified to discuss the general requirements and purpose of the application aircraft MSS. Intended usage and training requirements are covered in paragraph 6.1)

1.3 Document Overview. This System Specification volume defines the system level requirements for the _____ *(insert application aircraft type)* MSS. The additional volumes of the System/Segment Specification (SSS) contain segment unique requirements for design of the individual MSS segments. The system level requirements consist of MSS structure, communication architecture, network interface performance, system diagnostic and test requirements, programming language applicability, adaptability and expandability, and other requirements that pertain to all segments. The requirements contained in this volume combined with those contained in the specific segment volume comprise the complete set of requirements for each specific segment.

2. APPLICABLE DOCUMENTS

(List only those documents explicitly referenced within this volume.)

2.1 Government Documents. The following documents, of the exact issue shown, form a part of this specification to the extent specified herein. In the event of conflict between the documents referenced herein and the contents of this specification, the contents of this specification shall be considered a superseding requirement.

SPECIFICATIONS:

Federal - *(Identify applicable federal specifications)*
Military - *(Identify applicable military specifications)*
Other Government Agency - *(Identify applicable government specifications)*

STANDARDS:

Federal - *(Identify applicable federal standards)*

FED-STD-595	Colors
FED-STD-H28	Screw Thread Standards

Military - *(Identify applicable military standards)*

ANSI/MIL-STD-1815	ADA Programming Language
DOD-STD-2107	Production Assurance Program Requirements
DOD-STD-2167	Defense System Software Development
MIL-C-675	Coating of Glass Optical Elements
MIL-C-29025	Communication Systems for Training Devices, General Specification for
MIL-H-46855	Human Engineering Requirements for Military Systems, Equipment and Facilities
MIL-H-83282	Hydraulic Fluid, Fire Resistant, Synthetic, Hydrocarbon Base, Aircraft, Metric, NATO code number H-537
MIL-I-631	Insulation, Electrical, Synthetic Resin, Composition, Non-Rigid

MIL-P-29005	Publications, Planned Maintenance System for Training Devices
MIL-Q-9858	Quality Program Requirements
MIL-S-45743	Soldering, Manual Type, Host Reliability Electrical and Electronic Equipment
MIL-STD-108	Definitions of and Basic Requirements for Enclosures for Electric and Electronic Equipment
MIL-STD-129	Marking for Shipment and Storage
MIL-STD-130	Identification Marking of U.S. Military Property
MIL-STD-143	Standards and Specifications, Order of Precedence for the Selection of
MIL-STD-198	Capacitors, Selection and Use of
MIL-STD-199	Resistors, Selection and Use of
MIL-STD-200	Electronic Tubes, Selection of
MIL-STD-275	Printed Wiring for Electronic Equipment
MIL-STD-429	Printed Wiring and Printed Circuit Terms and Definitions
MIL-STD-454	Standard General Requirements for Electronic Equipment
MIL-STD-461	Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference
MIL-STD-470	Maintainability Program for Systems and Equipment
MIL-STD-483	Configuration Management Practices for Systems, Equipment, Munition and Computer Programs
MIL-STD-681	Identification, Coding and Application of Hookup and Lead Wire
MIL-STD-701	Lists of Standard Semi-conductor Devices
MIL-STD-721	Definition of Terms for Reliability and Maintainability

MIL-STD-785B	Reliability Program for Systems and Equipment Development and Production
MIL-STD-965	Parts Control Program
MIL-STD-1399	Interface Standard for Shipboard Systems
MIL-STD-1472	Human Engineering Design Criteria for Military Systems, Equipment and Facilities
MIL-STD-1558	Six-Degree-of-Freedom Motion System Requirements for Aircrew Member Training Systems
MIL-STD-1777	Internet Protocol Specification
MIL-T-23991	Training Devices, Military; General Specification for
MIL-W-8160	Wiring, Installation of, General Specification for

Other Government Agency - *(Identify applicable government standards)*

W-C-596	Connectors, Electrical, General Purpose

DRAWINGS: *(Identify applicable government drawings)*

OTHER PUBLICATIONS:

Manuals - *(Identify applicable government manuals)*
Regulations - *(Identify applicable government regulations)*
Handbooks - *(Identify applicable government handbooks)*
Bulletins - *(Identify applicable government bulletins)*

Copies of specifications, standards, handbooks, drawings, publications and other Government documents required in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer.

(In this paragraph list only those documents which are explicitly referenced within this specification volume.)

2.2 Non-Government Documents. The following documents, of the exact issue shown, form a part of this specification to the extent specified herein. In the event of conflict between the documents reference herein and the contents of this specification, the contents of this specification shall be considered a superseding requirement.

SPECIFICATIONS: *(Identify applicable non-government specifications)*

754-1985	IEEE Floating Point Specification
802.2	IEEE Logical Link Control Specification

STANDARDS: *(Identify applicable non-government standard)*

ANSI X3T9.5/84-49 (Rev 5.0 draft)	FDDI-Station Management
ANSI X3.139-1987	FDDI-Token Ring Media Access Control
ANSI X3.148-1988	FDDI-Physical Layer Protocol
ANSI X3.166-1989	FDDI-Physical Layer Medium Dependent

DRAWINGS: *(Identify applicable non-government drawings)*

OTHER PUBLICATIONS: *(Identify applicable non-government publications)*

Technical society and technical association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal Agencies.

(In this paragraph list only those documents which are explicitly referenced within this specification volume.)

3. SYSTEM REQUIREMENTS

3.1 Definition. The fundamental architecture for a MSS consists of twelve unique segments. Figure 1 provides a block diagram for the fundamental MSS architecture. Multiple segments may be combined within a single computational system to form a single module. Individual segments communicate with each other via the MSS Virtual Network (VNET). The MSS VNET allows intersegment communication via either a physical link *(Fiber Distributed Data Interface (FDDI), reflective memory, shared memory, etc.)* , or a software interface within the same computer. For the _____ *(insert application aircraft type)* MSS, the following MSS segments shall be provided:

a. Flight Station
b. Flight Controls
c. Flight Dynamics
d. Propulsion
e. Navigation/Communication
f. Weapons
g. Radar
h. Electronic Warfare
i. Physical Cues
j. Visual
k. Instructor Operator Station
l. Environment

(Modify the generic list of segments and Figure 1 to correspond with the segments required for the specific application. For example, delete "Weapons" and "Electronic Warfare" segments for tanker or transport aircraft applications. Additional statements may be added which state the purpose of the specific simulator.)

3.2 Characteristics

3.2.1 Performance Characteristics. The performance characteristics of the _____ *(insert application aircraft type)* MSS shall be as described in the following paragraphs. All MSS segments shall provide the capabilities as specified herein.

(Applicable sections of MIL-T-23991 should be cited in this paragraph.)

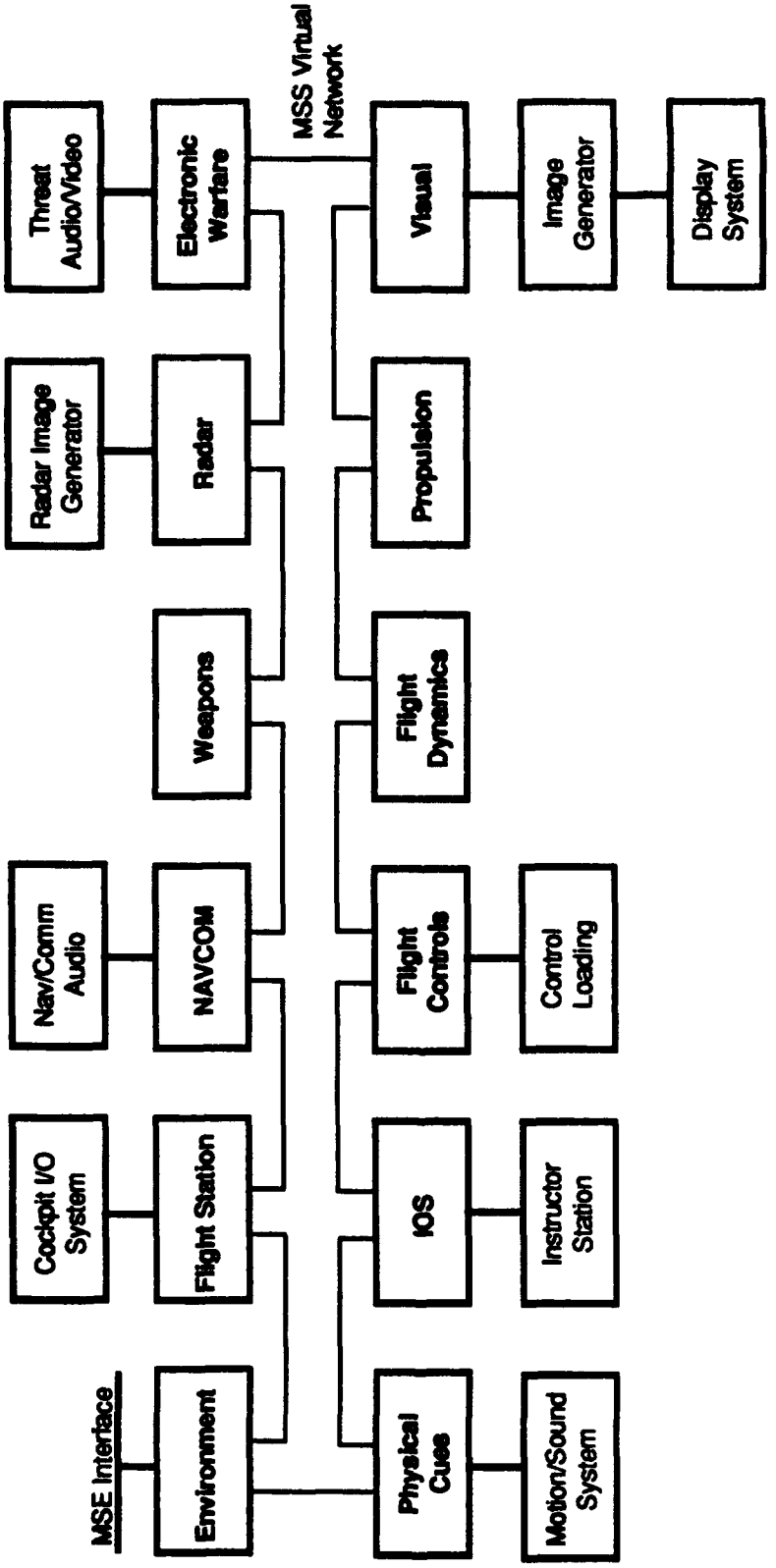

FIGURE 1 - FUNDAMENTAL MSS ARCHITECTURE

3.2.1.1 System Modes and States. Each segment in the _____ *(insert application aircraft type)* MSS shall operate within the set of system level modes and states as defined in the following paragraphs. All segments within the system shall be capable of transitioning among the modes as shown in FIGURE 2. Normal transition from System Mode to Segment Mode shall be via a shutdown mode request. Segment transitions from shutdown mode to segment mode shall not cause a break or discontinuity in the MSS VNET. System mode and state control shall be performed via the Instructor Operator Station (IOS) segment. Segment mode and state control shall be as defined in the MSS Interface Definition Document (IDD).

(System mode and state interface definition shall be tailored for the program as defined in the IDD. Reusability of segments and interfaces mode and state configuration should be preserved. It is possible to add states within a mode, but the addition of new modes is prohibited. Strict adherence to the state transition diagrams is recommended.)

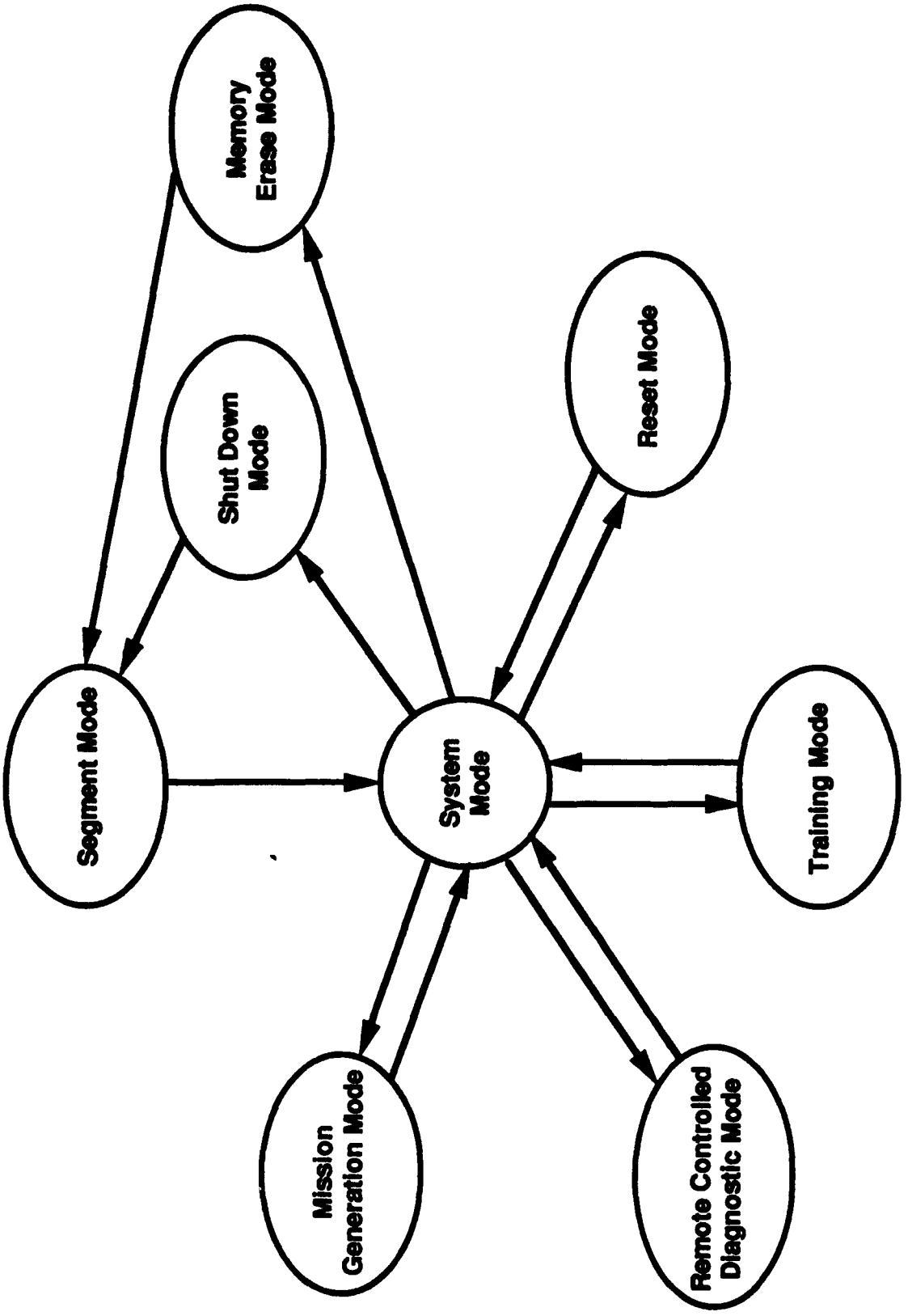

FIGURE 2 - MODULAR SIMULATOR SYSTEM MODE TRANSITION DIAGRAM

3.2.1.1.1 Segment Mode. Each _____ *(insert application aircraft type)* MSS segment shall initialize in the segment mode. When a segment is operating in the segment mode, it shall not cause a break or discontinuity in the MSS VNET. During segment mode operations, the segment shall be in an undefined state with respect to the system (i.e. it shall operate as a stand-alone entity). It shall not communicate with the MSS VNET until the segment has transitioned to system mode via an internal segment request. The system mode transition request shall occur after the segment has completed mandatory segment mode tasks. During segment mode, the segment shall perform tasks which are internal to the segment. Tasks may consist of software development, maintenance and repair work, local segment hardware or software diagnostics or preparation for system mode operations. Prior to system mode transition, a segment shall perform the following tasks *(specify either manually or automatically)*:

a. Startup. During the startup sequence, segment power shall be applied. Power shall be applied to all computational system hardware components (e.g. flight deck, backdoor interfaces, linkage, etc.), and peripherals, required for system mode operation.

b. Load System Software. Following completion of the startup sequence, the software required for system level operations, shall be loaded into the segments computational system.

c. Checkout. Following segment initialization and software loading, the segment shall perform a series of checks to ensure its integrity to support system mode operations. These checks shall be performed prior to system mode transition. A segment shall not transition to system mode with known hardware or software faults which could impair system operation.

3.2.1.1.2 System Mode. Each segment shall have transitioned from segment mode and is considered to be in a ready state with respect to the system. During system mode operations, each segment shall be fully connected to the MSS VNET. The segment shall be in a wait state and shall only perform mode transitions. Each segment shall collect data from the MSS VNET, and respond to mode transition commands from the IOS segment. The System Modes shall consist of:

a. Reset
b. Mission Generation
c. Training
d. Remote Controlled Diagnostic
e. Memory Erase
f. Shutdown

3.2.1.1.2.1 Reset Mode. Each Segment shall reset all internal functions to a known state and automatically transition back to system mode. Each segment shall accomplish a hardware reset followed by operational software reload.

3.2.1.1.2.2 Mission Generation Mode. This mode shall provide the capability to define a set of initial conditions, and other mission related parameters, which comprise a mission. Mission parameters shall be available to all segments for utilization during training mode.

(The Mission Generation task is generally performed on an off-line system. A specific application may require use of the training equipment for mission generation. Even when missions are generated off-line, some trainer post processing may be required to complete the mission build process. Specific requirements for mission generation operations should be specified in this paragraph.)

3.2.1.1.2.3 Training Mode. This mode shall allow the MSS to execute real time simulation software in support of real time crew training activities. All segments shall be in system mode prior to the MSS entering training mode. The state transition diagram for the training mode states shall be as shown in FIGURE 3. Training mode shall consist of the following four states:

a. Initialization
b. Alignment
c. Total Freeze
d. Run.

Each state shall be as described in the following paragraphs.

3.2.1.1.2.3.1 Initialization State. This state shall cause the real time simulation software to initialize with a predefined set of data. Initial conditions shall be stored in the IOS segment, or local to the segment, for future use during training mode. Predefined data shall be provided by either default values or mission specified data. Each segment shall transition from this state to the alignment state once initialization has completed.

(Additional paragraphs may be added to this section to define specific missions to be included in the initialization set or a minimum amount of predefined mission data sets.)

3.2.1.1.2.3.2 Alignment State. This state shall cause the MSS to enter a steady state condition utilizing predefined initial conditions. All instruments and onboard computer systems shall be set/reset to known conditions/states. When alignment is complete, the segment shall transition to the Total Freeze state.

(Any unique alignment requirements should be specified in this paragraph. Any specific segment responses should be included in the applicable segment specification.)

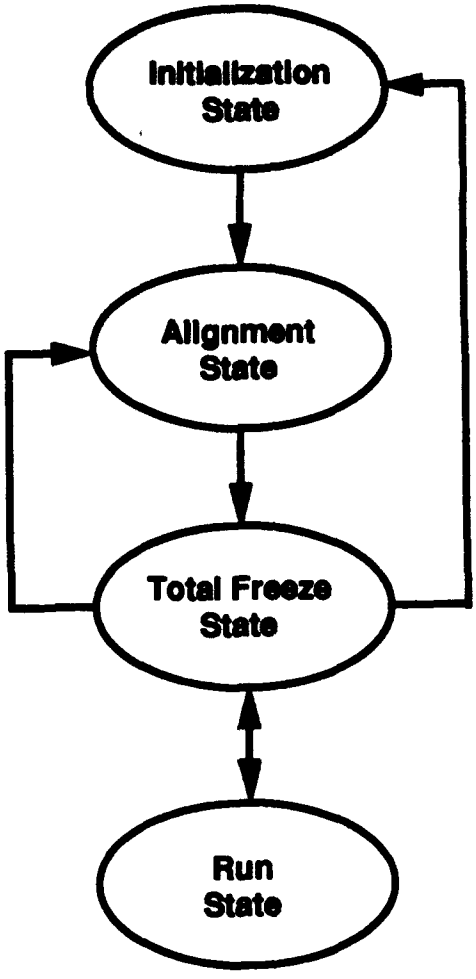

FIGURE 3 - Training Mode State Transition Diagram

3.2.1.1.2.3.3 Total Freeze State. This state shall cause all system simulations to cease execution. In the Total Freeze State, all MSS segments shall maintain communication with the MSS VNET. Transition to initialization, alignment, or run state shall be permitted.

3.2.1.1.2.3.4 Run State. This state shall cause the MSS to execute real time simulation software. The system shall be capable of transitioning from this state to Total Freeze.

(There may be additional freeze conditions which affect only one or two segments (e.g. Position Freeze, Flight Freeze, Total Fuel Quantity Freeze, etc.). Additional freeze conditions should be defined in this paragraph, and in the appropriate specification volume (e.g. IOS, Flight Controls, etc.).)

3.2.1.1.2.4 Remote Controlled Diagnostic Mode. This mode shall provide the capability for the IOS segment to request another segment perform a system level or local diagnostic service on itself. To request a remote controlled diagnostic, the segment must be in an on-line state. All remote controlled diagnostics shall be accomplished in accordance with, and shall consist of, those remote controlled diagnostics listed in the _____ *(insert application aircraft type)* MSS IDD. A segment shall remain in remote controlled diagnostic mode until commanded to system mode by the IOS segment.

(The extent of the self test capability is dependent on the support concept. System diagnostic capability should be enumerated in this paragraph (e.g. on-line diagnostics, off-line diagnostics, etc.). The specific test capability required for each segment should be described in the appropriate segment specification. Subparagraphs should be added to describe tests which are applicable to more than one segment.)

3.2.1.1.2.5 Memory Erase Mode. The segment shall transition to segment mode and erase all segment memory space. The segment response shall be identical to that specified for shutdown mode, except the segment shall not transmit a final shutdown active mode selection reply. Additional actions required to secure the segment shall be performed (e.g. erasing of files on non-removable disks, causing embedded avionics to declassify, etc.).

(This paragraph will require tailoring to meet the computational system security requirements for the specific program. For the MSS where security is not required, the functional capability of the memory erase mode shall not be implemented.)

3.2.1.1.2.6 Shutdown Mode. The IOS segment shall command each segment to transition from system mode to shutdown mode. Each segment shall accomplish an orderly shutdown of all system level processes. Shutdown shall not require power down, unless the MSS VNET can be maintained with segment power removed. Each segment shall send a final shutdown active mode selection reply to the IOS immediately prior to discontinuing communication with the MSS VNET. Upon completion of shutdown mode activities, the segment shall transition to segment mode.

(Specific shutdown activities that may be required for an application should be identified in this paragraph. Examples include the shutdown of special equipment or communication of the shutdown command to external devices.)

3.2.2 System Capability Relationships. The _____ *(insert application aircraft type)* MSS system capability relationships shall be as stated in the following paragraphs. The _____ *(insert application aircraft type)* MSS comprises a set of functions which simulates the _____ *(insert application aircraft type)* aircraft. Each simulation function shall simulate the functional and performance attributes

of the _____ *(insert application aircraft type)* aircraft in accordance with design criteria. Individual simulation functions shall be assigned to one and only one segment. Transitions, or hand-offs, of simulation functions shall not be allowed. The predefined functional allocation to MSS segments shall be adhered to.

3.2.2.1 Common Processing Service Functions. Common processing service functions are special functions that are allocated to a specific segment. Service functions provide a common processing service for several segments in the system. The results are transmitted across the VNET for use by other segments. Each system service function shall be assigned to a specific segment; that assignment shall not be transferred to any other segment. A segment may provide itself with a service function instead of utilizing the system service function. This shall be allowed as long as system fidelity is not deteriorated.

Service functions shall be assigned for the _____ *(insert application aircraft type)* MSS, as follows:

a. Occulting Function. This function shall be provided by the _____ *(segment name)* segment. Occulting service function requirements applicable to the _____ *(insert application aircraft type)* MSS shall include:

(This service function is generally computed by the visual or radar segment, in a MSE, the environment segment is responsible for this function. Requirements for this service function should be listed. Examples of occulting would be terrain masking or loss of threat detection.)

b. Spatial Relations Function. This function shall be provided by the _____ *(segment name)* segment. Slant/laser ranging or position fixing service function requirements applicable to the _____ *(insert application aircraft type)* MSS shall include:

(This service is generally computed by the radar or visual segment as a service for the Electronic Warfare (EW) and Weapons segments. Specific performance requirements for this service function should be listed. Examples may include laser range finding data or slant range data requirements)

c. Radar Database Function. This function shall be provided by the _____ *(segment name)* segment. The radar database/gaming area service function requirements applicable to the _____ *(insert application aircraft type)* MSS shall include:

(This service is generally computed by the radar or visual segment as a service for the EW , Radar, or Weapons segments. Specific performance requirements for this service function

should be listed. Examples may include providing the location of a target to the weapons segment, or providing a threat location.)

d. Visual Database Function. This function shall be provided by the _____ *(segment name)* segment. The visual database/gaming area service function requirements applicable to the _____ *(insert application aircraft type)* MSS shall include:

(This service is generally computed by the visual segment as a service for the EW or Weapons segments. Specific performance requirements for this service function should be listed. Examples may include providing the location of a target to the weapons segment, or providing a threat location.)

(Additional service function requirements may be added to this paragraph as required. Requirements for additional service functions must be identified in the appropriate segment specification. It will also be necessary to add interfaces to the application aircraft MSS IDD to define the transfer message.)

3.2.2.2 Simulator Support Programs. Support programs shall be developed to assist in fault detection and isolation capabilities for the _____ *(insert application aircraft type)* MSS. Support programs shall be designed to operate independently of the operational program and shall include the following:

a. Diagnostic features and diagnostic programs provided by equipment manufacturers for use on their equipment.

b. Programs to perform the software testing.

(Support programs include off-line test and specialized qualification test software such as autotest. This also includes all performance gathering programs, test and diagnostic programs. Additional requirements for this type of program should be listed in this paragraph.)

3.2.2.3 Common Databases. Access to common databases shall be via backdoor connections from the individual segments to the database. A single segment shall be assigned the responsibility for controlling the shared database. Common databases may be accessed through a backdoor interface, however, they shall not be modified, except by the controlling segment, during real-time operations. This does not preclude downloading of databases between segments across the MSS VNET or a backdoor bus during non-real-time operation. Files for diagnostics may be passed in the non real-time simulation in the same manner.

3.2.3 External Interface Requirements. The _____ *(insert application aircraft type)* MSS shall be of such design to interface with the installation facility in accordance with the Facility Design Criteria document.

(The simulator will generally be required to interface with facility power, fire detection system, hydraulics, etc. It may also be a requirement to network with other simulation devices to support multiple simulator training exercises. These types of external interfaces should be specified in this paragraph.)

3.2.4 Physical Characteristics. The _____ *(insert application aircraft type)* MSS shall be of modular construction, with major subassemblies connected by cables, electrical lines, hydraulic lines, and pneumatic lines *(specify the required interconnection capabilities)*. Special tools or equipment shall not be required for assembly or disassembly of major components. A means shall be provided for leveling each major component, if components require leveling.

Use of commercial off-the-shelf equipment is encouraged when performance requirements of the equipment satisfy requirements set forth in this specification. Commercial off-the-shelf equipment utilized in construction of the _____ *(insert application aircraft type)* MSS must be fully supported by the manufacturer. The use of commercial off-the-shelf equipment for processing resources shall meet the requirements as specified in paragraph 3.2.8.1, Computational Resources, of this volume.

Commercial off-the-shelf equipment shall be exempt from the parts control and hardware standardization requirements of this specification. However, its use shall not preclude the _____ *(insert application aircraft type)* MSS from meeting all other requirements of this specification.

(This paragraph is descriptive in nature, and should state the physical characteristics of the MSS, e.g. single cockpit, four crew stations, etc.)

3.2.4.1 Protective Coatings. Protective coatings shall be in accordance with the requirements of MIL-F-14072.

(Review MIL-F-14072 to determine specific finish requirements for the MSS program.)

3.2.4.2 Size and Weight. Size and weight requirements applicable to the _____ *(insert application aircraft type)* MSS shall as specified below.

(Specify simulator size and weight requirements. Size and weight restrictions may be imposed due to installation site limitations, transportation vehicle size limitations, or personnel lifting restrictions. Installation site limitations may include room heights, floor area, loading limits, door sizes, or elevator weight limits.)

3.2.4.3 Color. The paint to be used on the _____ *(insert application aircraft type)* MSS shall be from the semigloss series of FED-STD-595.

(Specific colors shall be selected by the simulator procuring agency or based on the aircraft design criteria.)

3.2.4.4 Lighting. Lighting required for operation and maintenance of the _____ *(insert application aircraft type)* MSS shall be provided. Instructor station lighting shall be in accordance with Human Engineering design criteria specified in MIL-STD-1472 *(insert applicable sections)*. Crew station functional lighting components shall be in accordance with design criteria for the _____ *(insert application aircraft type)*. Supplementary lighting shall be provided in maintenance areas where ambient lighting is insufficient. Open bulbs shall be guarded against accidental breakage and personnel contact.

(Explicitly reference only those paragraphs of MIL-STD-1472 that apply to the application trainer. This paragraph should also address shrouding requirements, to prevent undesirable reflections in the crew compartment. Any specific requirements for emergency lighting, or maintenance lighting, should be specified.)

3.2.4.5 Climate Control. Means shall be provided for maintaining the environment at an acceptable working temperature for all crew members and instructors. Air controls and air outlets shall be provided, as required, to maintain a comfortable (68°F ± 5°) environment. The crew station air conditioning system shall be designed for integration with the facility.

(This paragraph may also include noise abatement and crew comfort requirements. Subparagraphs should be added to identify specific trainer climate control requirements, facility requirements, and any unique facility interface requirements.)

3.2.4.6 Computational System Power Protection. The processing system shall incorporate power interrupt fail-safe provisions. Unexpected loss of power shall not result in damage to the processors or associated peripheral equipment.

(Specialized power conditioning may be required to ensure adequate protection from power transients. These systems should be identified in this paragraph.)

3.2.5 System Quality Factors. The quality factor requirements for the design and development of the _____ *(insert application aircraft type)* MSS shall be as specified in the following paragraphs.

3.2.5.1 Reliability. The _____ *(insert application aircraft type)* MSS reliability shall meet the reliability requirements specified in MIL-T-23991 and, in addition, meet the requirements specified in the following paragraphs. Reliability considerations shall apply to GFP and commercial off the shelf items. The _____ *(insert application aircraft type)* MSS reliability program shall be in accordance with MIL-STD-785B, and as specified in the Statement of Work

(SOW). Definitions of terms shall be as specified in MIL-STD-721.

(Additional subparagraphs may be required to specify the system reliability requirements.)

3.2.5.1.1 MSS Reliability. The _____ *(insert application aircraft type)* MSS shall have a mission reliability (probability of successfully completing a mission) of _____ percent.

(The system reliability will generally be specified by the procuring agency. The figure contained in this paragraph is the reliability for the entire system. A reliability analysis must be accomplished to determine the required reliability for each segment. Segment reliability requirements are contained in each specific volume.)

3.2.5.1.2 Mean Time Between Failure (MTBF). The _____ *(insert application aircraft type)* MSS shall be based upon the Mean Time Between Critical Failure (MTBCF). MTBCF is defined as a failure which causes an interruption of training and requires a maintenance action to allow the system to operate properly again. The _____ *(insert application aircraft type)* MSS MTBCF shall be not less than _____ hours.

(The MTBF value contained in this paragraph pertains to the entire system. A reliability analysis must be accomplished to allocate each segment's MTBF requirement. Segment MTBF requirements are contained in each specific volume.)

3.2.5.2 Maintainability. The _____ *(insert application aircraft type)* MSS maintainability program shall be in accordance with MIL-STD-470, and the requirements defined in MIL-T-23991 as specified in the following paragraphs. Maintainability requirements shall be applicable to Government Furnished Property (GFP), and commercial off the shelf hardware, to the extent specified below. Scheduled maintenance shall be organized into work packages in accordance with MIL-P-29005. Definitions of Maintainability Program terms shall be as specified in MIL-STD-721.

(Maintainability requirements for the total MSS should be specified in terms of MTTR, Maximum repair time, daily maintenance time, and on equipment replacement time. Specific sections of MIL-STD-470 and MIL-P-29005 which apply should be cited. The SOW should specify maintainability analysis tasks to be performed for the MSS.)

3.2.5.2.1 Mean and Maximum Time To Repair. The _____ *(insert application aircraft type)* MSS shall have a Mean-Time-To-Repair (MTTR), μ_c, of ____ hours. The ____ percentile maximum corrective maintenance time shall not exceed ____ hours.

(The MTTR requirement contained in this paragraph pertains to the entire system. A complete reliability analysis must be accomplished to allocate MTTR requirements for each segment. Individual segment MTTR requirements should be contained in each specific volume.)

3.2.5.2.2 Mean Time Between Maintenance (MTBM). The _____ *(insert application aircraft type)* MSS shall have a MTBM of ____ hours.

(The MTBM contained in this paragraph pertains to the entire system. A complete reliability analysis must be accomplished to allocate MTBM requirements for each segment. Individual segment MTBM requirements should be contained in each specific volume.)

3.2.5.3 Availability. The _____ *(insert application aircraft type)* MSS shall be ready for training at least ____ percent of the time when a training mission is scheduled.

(The required availability and criteria for calculating availability should be stated explicitly. References to specific paragraphs of MIL-STD-721 should be cited. MIL-T-23991 provides a method for calculating achieved availability which is commonly employed.)

3.2.5.4 Additional Quality Factors. Additional quality factors requirements, applicable to the _____ *(insert application aircraft type)* MSS, are specified in the following paragraphs.

(Additional quality factors such as integrity, efficiency, or fidelity requirements for the system may be added as additional subparagraphs, when applicable.)

3.2.5.4.1 Software Quality. All simulator software shall be developed in the Ada software language in accordance with MIL-STD-1815A. Ada programming requirements shall not apply to unmodified manufacturer's software, existing software, or commercial off-the-shelf software.

(If there are code restrictions or limits for modification of existing sofware, they should be identified in this paragraph)

3.2.5.4.2 Ada Programming Support Environment. Validated Ada compilers, assemblers, linkers, and software support tools shall be used to develop Ada software. To the extent possible, tools used in the design and support of the _____ *(insert application aircraft type)* MSS shall be commercially available.

3.2.6 Environmental Conditions. The _____ *(insert application aircraft type)* MSS shall be designed to withstand the temperature, relative humidity, and barometric pressure requirements of MIL-T-23991 "Climatic conditions" (3.2.1.5.1).

3.2.7 Transportability The _____ *(insert application aircraft type)* MSS shall be designed to best commercial practices for transportability. Operational characteristics of the _____

(insert application aircraft type) MSS components shall be suitable for normal transportation methods. Strengthened tie points and hoisting, or lifting, provisions shall be provided in the design to ease relocation.

(Specific program transportability requirements should be listed in this paragraph. Examples might include the ability to be rapidly relocated via a rail system, or a tractor trailer rig.)

3.2.8 Flexibility And Expansion. The _____ *(insert application aircraft type)* MSS shall be designed with the flexibility to incorporate _____ *(insert application aircraft type)* aircraft updates, and new training requirements, with a minimum number of design changes to the system and segment level components. Adequate expansion capability, particularly from the computational system resources of spare time, memory, and Input/Output (I/O) shall be provided to incorporate aircraft modifications which occur during _____ *(insert application aircraft type)* MSS development. This capability shall allow for system changes (e.g. those changes resulting from changes to training requirements, aircraft data, aircraft configuration, and mission changes) with minimum impact on system operation, maintenance, and student training.

(An application may not initially implement all MSS capabilities. Provisions to implement additional simulator capabilities should be a design consideration. This may impact structure, power, floor space, and interfaces. For example, an MSS may not, initially, be provided with a motion system; however, the procuring agency may subsequently develop a requirement for a motion system.)

3.2.8.1 Computational Resources. A computational system shall be provided which shall meet the performance requirements and tolerance levels described in this specification. Processors, and peripheral devices, shall consist of commercially available equipment fully supported by the manufacturer. All computational resources shall be capable of expansion to meet future program training requirements.

(It is assumed that the MSS developer will be utilizing an off-the-shelf computational system for processing. If a requirement exists to develop a special purpose computer, then the requirements should be elaborated in this paragraph.)

3.2.8.1.1 Computational System Memory. Each processor shall have sufficient installed memory to store and execute the complete operational program, or any support program, required for that segment. The computational system memory shall be sufficient to meet the spare memory requirements specified in paragraph 3.3.11.

3.2.8.1.2 Mass Storage Systems. Direct access mass storage equipment shall be provided as part of the _____ *(insert application aircraft type)* MSS. Each segment shall have sufficient mass storage

capability to support its operational software, diagnostic facilities, databases, etc. which are required to operate the specific segment. The storage media shall be removable without use of special tools. The mass storage system shall have sufficient capacity to meet the spare requirements of paragraph 3.3.11.

3.2.9 Portability. The _____ *(insert application aircraft type)* MSS shall be of such design to withstand transportation in a commercial padded van over representative U.S. highways, or in a cargo aircraft, without damage or degradation to system performance.

(Aircraft simulators are generally installed in a permanent facility and rarely moved. If the procuring agency has a requirement to remotely deploy the MSS, then this paragraph should detail those requirements. Consideration must be given to tear down time, preparation for movement, and set-up at the new training site. Physical and environmental requirements of paragraph 3.2.1 and 3.2.2 should be tailored to the satisfy the requirements.)

3.3 Design and Construction The design and construction of the _____ *(insert application aircraft type)* MSS shall be in accordance with the requirements of MIL-T-23991, paragraph 3.2, "Design".

(MIL-T-23991, paragraph 3.2 and subparagraphs, should be reviewed for any additional requirements or exceptions for the specific program. Exceptions, or additions, should be contained in this paragraph.)

3.3.1 Materials, Parts, Processes. Materials, parts, and processes used in the design and construction of the _____ *(insert application aircraft type)* MSS shall be in accordance with the requirements of MIL-T-23991, paragraph 3.1, "Materials, parts, and processes". Hydraulic fluid shall meet the requirements of MIL-H-83282.

(MIL-T-23991, paragraph 3.1 and subparagraphs, should be reviewed for any additional requirements or exceptions for the specific program. Exceptions, or additions, should be contained in this paragraph. Cite specific paragraphs from MIL-H-83282 which apply. Best commercial practices may be identified whenever practical.)

3.3.1.1 Toxic Products. In general, materials producing harmful toxic effects shall not be used in the design and construction of the _____ *(insert application aircraft type)* MSS. Neither asbestos material nor parts containing asbestos shall be used in the _____ *(insert application aircraft type)* MSS.

(Cite additional toxic products or hazardous material restrictions applicable to the specific program. Use of products containing chloroflourocarbons (CFC) are presently undergoing restriction in government programs.)

3.3.2 Electromagnetic Radiation. The _____ *(insert application aircraft type)* MSS design shall be designed in accordance with MIL-T-23991 "Electromagnetic Interference Suppression" (3.8). The design shall satisfy MIL-STD-461, Part 2, susceptibility requirements CE03, CS06, RE02, and RS03.

(MIL-STD-461 Part 2 is applicable to Air Force procurements; part 4 is applicable to Navy or Army procurements. These requirements must be adjusted to meet program emission requirements.)

3.3.3 Nameplate And Product Markings. Nameplate and product markings shall be in accordance with MIL-T-23991 "Nameplates or Product Markings" (3.13), and first tier reference MIL-STD-130.

(Add specific paragraphs of MIL-STD-130 which apply.)

3.3.4 Workmanship. Major system components, including assemblies, parts and accessories, shall be constructed and finished using high quality workmanship and best commercial practices. The requirements of MIL-T-23991, paragraph 3.15, "Workmanship", shall be used for general guidance. Particular attention shall be given to neatness; thoroughness of soldering, wiring, marking of parts and assemblies; and freedom from burrs and sharp edges. Prior to government acceptance, all equipment/components shall be cleaned and blemishes refinished.

3.3.5 Interchangeability. All equipment/components, including all assemblies, parts and accessories, shall be constructed of standard parts/units wherever possible. All parts having the same part number, shall be directly and completely interchangeable with respect to installation and performance regardless of source of part or assembly. The requirements of MIL-T-23991, paragraph 3.2.1.1, "Interchangeability", shall be used for general guidance. The following equipment/components of the _____ *(insert application aircraft type)* MSS shall be interchangeable/interoperable.

(The remainder of this paragraph should list the equipment/components of the MSS that are directly interchangeable. This may include specific aircraft parts and hardware and/or segments that could be used among a family of training devices.)

3.3.6 Safety. The _____ *(insert application aircraft type)* MSS design shall be in accordance with MIL-T-23991 "Safety" (3.2.1.2). Emergency lighting shall be provided.

(Additional safety criteria may be required by the procuring agency or made necessary because of the proposed simulator configuration or installation site. These criteria should be listed in this paragraph.)

3.3.6.1 Emergency Power Switches. Emergency power switches shall be provided for the crew station, the instructor station, every equipment rack, and any remote area where personnel may be working that is unique to the _____ *(insert application aircraft type)* MSS design. Switches shall be clearly marked and readily accessible, and protected from inadvertent actuation.

(Additional power off switches or interlock relays should be specified, such as, drawbridge interlocks or safety belt relays/interlocks.)

3.3.6.2 Control Loading. The control loading system shall be designed to prevent rapid or forceful uncommanded control displacements upon energizing the system, during automatic retrimming, following inadvertent start-up from an untrimmed condition, or as a result of either an electrical or mechanical system failure, to avoid personnel injury.

(Other specific safety requirements applicable to the control loading system may be listed in this paragraph. If a control loading system is not incorporated in the MSS, then this paragraph may be omitted.)

3.3.6.3 Motion. The motion system shall be designed in accordance with the safety requirements of MIL-STD-1558.

(Specific paragraphs from MIL-STD-1558 should be cited. If a motion system is not incorporated in the MSS, then this paragraph may be omitted.)

3.3.6.4 Lasers. Lasers shall be utilized in accordance with MIL-T-23991 "Lasers" (3.2.4.5) and American National Standard Institute (ANSI) 2136.1.

(Cite specific paragraphs from ANSI 2136.1 which apply . Lasers are not normally used in flight simulators, they may be used in Head/Eye tracker devices and specific safety requirements should be listed in this paragraph. If lasers are not incorporated in the MSS, then this paragraph can be omitted.)

3.3.7 Human Engineering. The _____ *(insert application aircraft type)* MSS shall be designed in accordance with sound human engineering principles, particularly emphasizing man/machine interface considerations in the design. In cases where these practices would degrade the _____ *(insert application aircraft type)* MSS performance, performance design shall take precedence. The _____ *(insert application aircraft type)* MSS shall be designed utilizing MIL-T-23991 "Human Engineering" (3.2.1.6), including first tier reference MIL-H-46855, and MIL-STD-1472 as guides. The dimensions of the 5th to 95th percentile human male and female shall apply. The minimum requirement for control of noise generation and penetration shall be Curve 60 (NC-60), FIGURE 10 of MIL-STD-1472.

(Specify applicable paragraphs from MIL-H-46855 and MIL-STD-1472.)

3.3.8 Nuclear Control Requirements. There are no nuclear control requirements applicable to the _____ *(insert application aircraft type)* MSS.

3.3.9 System Security. The _____ *(insert application aircraft type)* MSS shall be capable of supporting _____ level security operations.

(Specify the level of security required by the procuring agency. Specific security requirements should be identified in this paragraph. This paragraph may be identified as NOT APPLICABLE, if there are no security requirements levied on the MSS program.)

3.3.10 Government Furnished Property (GFP). The GFP required to support development of the _____ *(insert application aircraft type)* MSS shall be as identified below.

Nomenclature	Specification Number	Part Number

(Specify the GFP, Government Furnished Information (GFI), or Government Furnished Software (GFS) which will be provided for use in the design and construction of the MSS. It is acceptable to defer the details of the GFP, GFI, or GFS to the SOW. The contractual details for obtaining the GFP, GFI, or GFS are generally contained in the Statement of Work.)

3.3.11 Computational Resource Spare Capacity. Spare computational system processor and memory requirements applicable to the _____ *(insert application aircraft type)* MSS shall be as specified in the following paragraphs. Each segment shall be designed to meet the requirements of the following paragraphs.

3.3.11.1 Processing capacity. The computational system shall have sufficient spare processing capacity to allow for a ___ *(insert number)* percent growth and a ____ *(insert number)* percent spare frame time during worst case conditions.

(The spare timing requirement will vary depending on the system architecture. Each segment may require a different spare requirement; expand this paragraph as necessary.)

3.3.11.2 Installed memory. Each processor shall have sufficient memory to meet the storage requirements for execution of the segments operational programs. Each processor shall utilize no more than ___ percent of the available amount of that processor's installed memory.

(Typically, a requirement of 50 percent spare capacity is desired. This paragraph may require expansion based upon the MSS architecture. It may be possible for each segment to have a different spare memory requirement. In addition, it may be more cost effective to specify a computational system with a certain amount of expansion capability.)

3.3.11.3 Mass storage. The storage capacity of the primary mass storage system shall be expandable by _____ percent.

(Typically, a requirement of 100 percent expansion will be levied on the spare requirement for mass storage system.)

3.3.11.4 Interface capacity. The total input and output channel capacities shall not exceed ___ percent of the available channel capacities. The available channel capacities shall be as required for worst case channel traffic for each channel for the _____ *(insert application aircraft type)* MSS.

3.4 Documentation. The documentation requirements for the _____ *(insert application aircraft type)* MSS shall be as specified in the contract. Software documentation shall be in accordance with DOD-STD-2167A.

(Generally, documentation requirements are contained in the contract with reference to specific Contract Data Requirement List (CDRL) items. This paragraph may be tailored to reflect any program unique documentation requirements.)

3.5 Logistics. Logistics requirements for the _____ *(insert application aircraft type)* MSS shall be as specified in the following paragraphs.

(The logistic requirements are generally contained in the Logistics Support Analysis. System level logistics requirements should be discussed in the following paragraphs.)

3.5.1 Maintenance. Unless otherwise specified, the _____ *(insert application aircraft type)* MSS shall be designed for maintenance in accordance with the requirements of MIL-STD-470.

3.5.2 Transportation Modes. The _____ *(insert application aircraft type)* MSS shall support transportation modes as specified in paragraph 3.2.7 of this specification volume.

(Additional transportation requirements may be specified in this paragraph.)

3.5.3 Supply System Requirements. Not Applicable.

(Specify the supply system requirements which will be required to support deployment of the simulator. New items introduced into the supply system should be identified. The method and location of supply stocks should be identified. The re-supply method(s) should be identified. These requirements may be contained in the LSA.)

3.5.4 Existing Facilities. The _____ *(insert application aircraft type)* MSS shall be housed in a _____ facility. The facility shall comply with the requirements specified in the Facility Design Criteria document.

(The type of facility (e.g. government provided, contractor provided, shipboard, etc.) should be identified in this paragraph. This paragraph should be tailored to identify specific existing facilities)

3.5.5 Existing Equipment. Equipment required to support the installation of the _____ *(insert application aircraft type)* MSS shall be provided by the government in accordance with the Facility Design Criteria document.

(This paragraph should be tailored to identify specific existing supplies which shall be employed in the particular program.)

3.6 Personnel and Training. The personnel and training requirements for the _____ *(insert application aircraft type)* MSS program shall be as specified in the following paragraphs.

3.6.1 Personnel. Personnel responsible for manufacture, inspection, test or control of processes, operations of equipment which require specialized skills shall be certified prior to performing these functions. The quantity and skill levels of personnel required to support the _____ *(insert application aircraft type)* MSS shall be as specified in the SOW.

(Additional contractor personnel requirements should be specified in this paragraph to meet the requirements of the procuring activity. Specific skills identified by job title, experience requirements, and duration of service should be described in this paragraph.)

3.6.2 Training. Training programs shall be established for personnel whose activities have an effect on the quality, reliability, maintainability, human engineering, or safety of the _____ *(insert application aircraft type)* MSS. Training requirements shall be as specified in the SOW.

(Additional training requirements should be specified in this paragraph to meet the needs of the procuring activity. If the MSS program has requirements to train government personnel, then these requirements must be addressed in this paragraph.)

3.7 Characteristics of Subordinate Elements. The _____ *(insert application aircraft type)* MSS shall be composed of ___ segments comprising ___ modules *(specify number of segments and modules for specific application)*. The _____ *(insert application aircraft type)* MSS architecture is depicted in FIGURE 4. *(Tailor Figure 4 to represent the system interconnection and major system components for the specific application MSS.)* Functional requirements for the _____ *(insert application aircraft type)* MSS shall be as described in the following paragraphs.

3.7.1 Flight Station Segment. This segment shall provide the simulation for the _____*(insert application aircraft type)* MSS ancillary

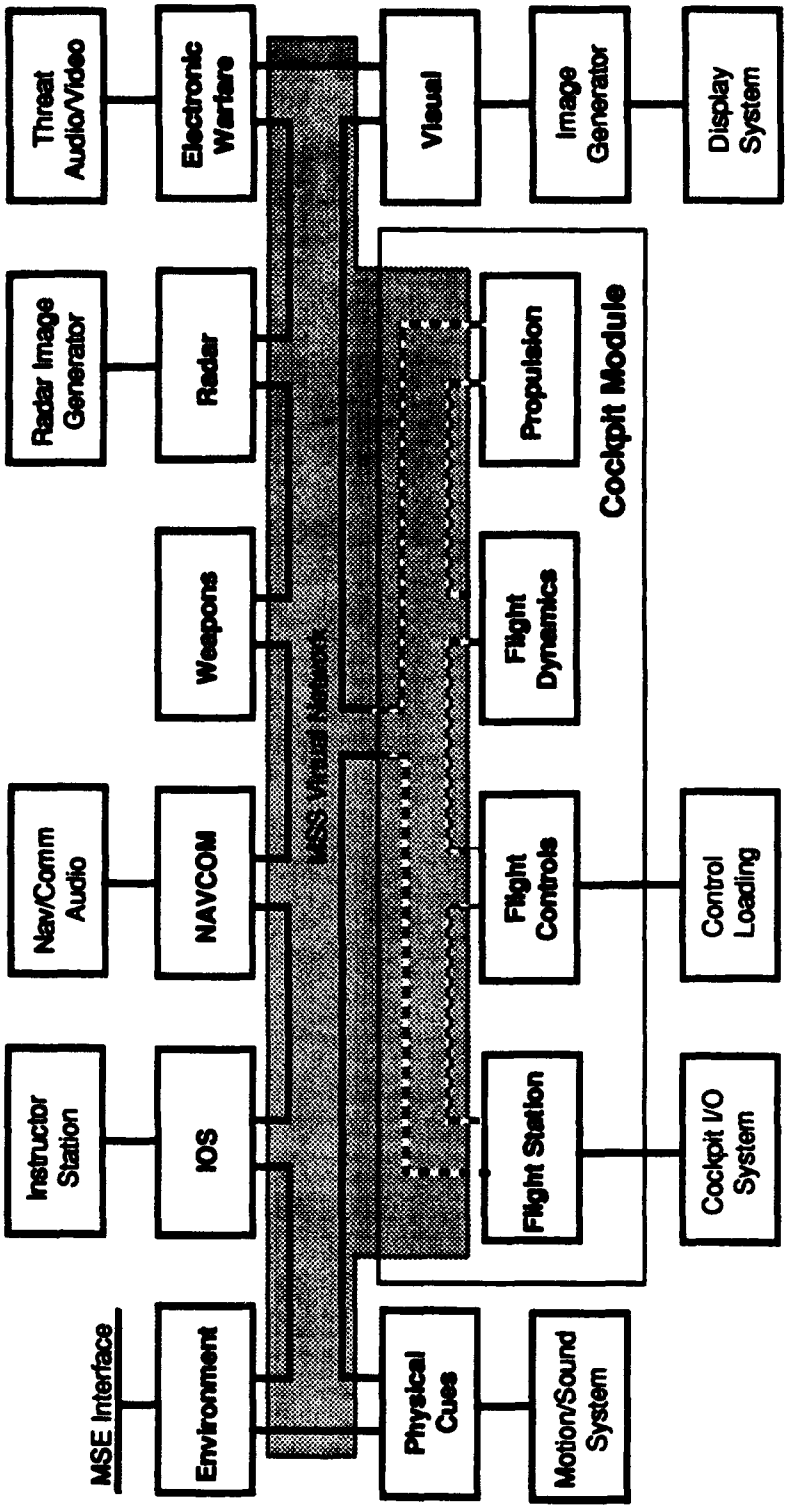

FIGURE 4 - _____ *(Application Aircraft Type)* MSS ARCHITECTURE

systems. This shall include simulation of the following systems *(tailor list for specific application)*:

a. Electrical System
b. Hydraulic System
c. Fuel Management System
d. Environmental Controls System
e. Pneumatic System
f. Auto Checklist
g. Oxygen System
h. Crew Station Interface

The Flight Station segment shall also provide the interface to the crew station Controls and Displays (C&D). Flight Station segment requirements are contained in volume II of this specification.

3.7.2 Flight Controls Segment. This segment shall provide the simulation for aircraft control surfaces, devices, and systems for the _____ *(insert application aircraft type)* aircraft. This shall include simulation of *(tailor list for specific application)*:

a. Primary Controls *(e.g. elevators, ailerons, rudders, rotor blades, etc.)*
b. Trim Function
c. Hinge Moment Function
d. Automatic Flight Control Systems
e. Miscellaneous Control Devices *(e.g. landing gear, weapon bay doors, toe brakes, anti-skid systems, etc.)*
f. Toe Brakes and Anti-Skid Systems

The Flight Controls segment requirements are contained in volume III of this specification.

3.7.3 Flight Dynamics Segment. This segment shall provide simulation of the aerodynamic qualities for the _____ *(insert application aircraft type)* aircraft. The Flight Dynamics segment shall also simulate the aircraft's structural limitations based on aerodynamic flight envelope violation and external crash conditions. This shall include simulation of *(tailor list for specific application)*:

a. Forces and Moments
b. Equations of Motion
c. Weight and Balance
d. Envelope Violation

The Flight Dynamics segment requirements are contained in volume IV of this specification.

3.7.4 Propulsion Segment. This segment shall provide the simulation of the engines and thrust generation capabilities for the _____ *(insert application aircraft type)* aircraft. This simulation shall include *(tailor list for specific application)*:

a. Core Engine System
b. Thrust Generation System
c. Starting System
d. Engine Inlet System
e. Engine Oil System
f. Engine Fuel System
g. Engine Bleed Air System
h. Transmission System
i. Exhaust System
j. Auxiliary/Emergency Power Units.

The Propulsion segment requirements are contained in volume V of this specification.

3.7.5 Navigation/Communication Segment. The Navigation/ Communication (NAVCOM) segment shall provide the navigation, communication, and identification simulations for the _____ *(insert application aircraft type)* aircraft. This simulation shall include *(tailor list for specific application)*:

a. Attitude Heading Reference Systems (AHRS)
b. Inertial Navigation System (INS)
c. Radar Altimeter
d. Radio Navigation Aids System
e. Communication System
f. Star Tracker System
g. Doppler Radar
h. Air Data System
i. Application Unique Avionics
j. Identification Friend or Foe (IFF)

The NAVCOM segment requirements are contained in volume VI of this specification.

3.7.6 Weapons Segment. This segment shall provide the simulation and modeling of all ownship weapons and ownship weapons systems. This simulation shall include *(tailor list for specific application)*:

a. Ownship Weapon Dynamics
b. Target Designation
c. Threat Weapon Damage Assessment
d. Ownship Fire Control
e. Ownship Weapon Stores

The Weapons segment requirements are contained in volume VII of this specification.

3.7.7 Radar Segment. This segment shall provide the simulation and modeling required to create radar display images for the radar sensors included on the _____ *(insert application aircraft type)* aircraft. The Radar simulation shall include *(tailor list for specific application)*:

a. Radar Processor
b. Radar Image Generation
c. Airborne Interrogation and Sensor Modeling
d. Radar Database Management
e. Radar Guidance
f. Mission Computer Interfaces
g. Radar Aircraft Systems Interface
h. Crew Station Hardware Interface
i. Ranging and Position Fixing
j. Terrain Occulting

The Radar segment requirements are contained in volume VIII of this specification.

3.7.8 Electronic Warfare Segment. This segment shall provide the simulation and modeling of the Electronic Warfare Equipment (EWE) included on the _____ *(insert application aircraft type)* aircraft. The EWE simulation shall include *(tailor list for specific application)*:

a. Expendable Countermeasures
b. Dedicated Displays
c. Electronic Countermeasures (ECM)
d. Warning Receiver
e. Threat Detection

The Electronic Warfare segment requirements are contained in volume IX of this specification.

3.7.9 Physical Cues Segment. This segment shall provide the motion and environmental sound cueing simulation for the _____ *(insert application aircraft type)* MSS. This segment shall provide the capability to model and control the following *(tailor list for specific application)*:

a. Motion Geometry, Cues, and Base
b. G-seat
c. Anti G-suit
d. Vibration and Buffet
e. Environmental Sounds

(The training requirements analysis should be evaluated before specifying Motion System requirements due to the additional complexity and cost added o the simulator system.

The Physical Cues segment requirements are contained in volume X of this specification.

3.7.10 Visual Segment. This segment shall provide out-the-window and visual sensor imagery for the _____ *(insert application aircraft type)* MSS. This segment shall include capabilities to model and control the following*(tailor list for specific application)*:

a. Image Generation
b. Moving Models
c. Scene Environment
d. Lighting Control
e. Visual Database
f. Visual Display Systems
g. Spatial Relations
h. Occulting
i. Collision Detection
j. Mission Computer/Display Processor Interfaces
k. Visual Crew Station Interfaces

The Visual segment requirements are contained in volume XI of this specification.

3.7.11 Instructor Operator Station Segment. The IOS segment shall provide the central point of control for the entire simulation system and associated training activities. The IOS segment shall control all segment mode and state transitions. Transition between autonomous device operation and the Multiple Simulator Environment (MSE) device operation shall be controlled by the IOS. The IOS segment shall provide the following monitoring, status, and control capabilities *(tailor list for specific application)*:

a. Ownship Controls Disagreement
b. Ownship Malfunction Control
c. Ownship Status and Control
d. Navigation Communication Status and Control
e. Physical/Natural Environment Status and Control
f. Tactical Environment/Mission Status and Control
h. Simulator Control
i. Crew Station Performance Monitoring and Measurement

The IOS segment requirements are contained in volume XII of this specification.

3.7.12 Environment Segment. The Environment segment shall provide the ownship external tactical and natural environment simulation. This segment also provides the network interface for operations within a MSE. MSE provides a means for accomplishing training with multiple training systems connected through a hardware link.

The Environment segment shall provide simulation and control of the following functions *(tailor list for specific application)*:

a. Atmospheric Modeling
b. Database Management
c. Navigation Database
d. Spatial Relations
e. Visual Database
f. Radar Database
g. Occulting
h. Ownship Weapon Damage Assessment
i. Entity Database
j. Entity Management
k. Entity Weapons
l. Entity Expendable Countermeasures
m. MSE Interaction

The Environment segment requirements are contained in volume XIII of this specification.

3.8 Precedence. In the event of a conflict between the requirements in documents referenced herein, the requirements of this specification shall take precedence. In the event of a conflict between requirements internal to this specification, the overriding requirement(s) shall be determined by mutual agreement between the Government and the _____ *(insert application aircraft type)* MSS prime contractor. System level requirements shall take precedence over segment level requirements unless specifically identified.

3.9 Qualification. The qualification test program shall be based upon sequential testing which minimizes redundant testing, and reduces the probability of test failure. The test concept shall include disciplined control of test configuration, timely conduct of test events, and verification of test results prior to beginning the next phase of testing. Validation and verification of the _____ *(insert application aircraft type)* MSS performance characteristics shall be in accordance with the tests identified in the following paragraphs. Details of the test program shall be contained in the _____ *(insert application aircraft type)* MSS System Test Plan (STP). Test configuration shall be controlled as specified in the _____ *(insert application aircraft type)* MSS Configuration Management Plan.

(The descriptions contained in the following paragraphs do not specifically identify how the MSS functions will be verified. This should be accomplished in the B Specification and the System Test Plan.)

3.9.1 Segment Testing. Each segment shall be individually qualified, prior to system level integration testing, to ensure the requirements of Section 3 have been satisfied. The following qualification testing shall be accomplished to provide stand-alone segment qualification.

(This paragraph is intended to include general requirements for the overall MSS. More detailed qualification requirements should be contained in the specific segment volume.)

a. Segment Development Test. At the completion of segment development, the segment contractor shall perform a dry run of the segment qualification tests prior to advancing into the next phase of testing. The segment development test phase shall be an informal test phase conducted solely by the segment contractor which shall verify compliance with Section 3 requirements for the applicable segment.

b. Segment Qualification Test. The segment contractor shall perform all stand-alone segment tests; tests shall be witnessed and approved by the prime contractor. The Government shall have the option of witnessing these tests.

(If multiple segments are included in a single module, then this paragraph may require tailoring to define a specific set of module tests.)

3.9.2 Integrated System Testing. Integrated system testing shall be accomplished to ensure the requirements of Section 3 are satisfied prior to formal government acceptance testing. The following qualification tests shall be accomplished to provide integrated system qualification.

a. Integrated Development Test. Integrated development testing shall consist of completion of all integration tests. The segment and prime contractors shall perform all integrated development tests. Integrated development testing shall be an informal test phase and shall be conducted prior to advancing into the system qualification test phase.

b. System Qualification Test. System qualification testing shall consist of the procuring activity accomplishing the qualification tests.

3.9.3 Installation and Checkout. The prime contractor shall perform a subset of the segment and system qualification tests, as defined in the STP, at the installation facility to verify proper _____ *(insert application aircraft type)* MSS operation following installation. Installation and checkout tests shall be witnessed by the Government.

3.10 Standard Sample. Not Applicable.

(Standard samples are required to illustrate characteristics of a system which cannot be evaluated with detailed test procedures. In general, all MSS capabilities shall be verifiable

through performance of test procedures. In the event that a standard sample is required, this paragraph should be modified accordingly.)

3.11 Preproduction Sample. Not Applicable

(This paragraph shall describe requirements for producing a preproduction sample MSS. In general, the MSS program will not require a preproduction sample. In the event that a preproduction sample is required, this paragraph should be modified accordingly.)

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Tests and Inspections. Quality assurance activities for the _____ *(insert application aircraft type)* MSS shall be as described in the following paragraphs. Quality assurance activities shall be conducted by the prime contractor, the segment subcontractor, and the procuring agency. Qualification activities shall comply with DOD-STD-2107 and MIL-STD-52779. The requirements contained in the following paragraphs are applicable to all MSS segments. Specific segment quality assurance requirements shall be identified within each segment's system specification. The specific details of the _____ *(insert application aircraft type)* MSS test program shall be contained in the _____ *(insert application aircraft type)* MSS STP. Responsibility for tests and inspections required during each phase of the _____ *(insert application aircraft type)* MSS qualification program shall be as follows:

a. Segment Development Test. The segment contractor shall be responsible for accomplishing all testing associated with Segment Development testing.

b. Segment Qualification Test. The segment contractor shall be responsible for accomplishing all testing associated with Segment Qualification testing. The prime contractor shall witness and approve all testing.

c. Integration Development Test. The prime and segment contractors shall conduct Integration Development testing.

d. System Qualification Test. The procuring agency shall have responsibility for conducting, and approving, System Qualification tests. The prime contractor shall provide technical support throughout this test phase.

e. Installation and Checkout. The prime contractor shall have responsibility for conducting Installation and Checkout tests. The procuring agency shall witness and approve all testing.

4.2 Special Tests and Examinations. Special tests and examinations, applicable to the _____ *(insert application aircraft type)* MSS shall be as defined in the following paragraphs.

4.2.1 Test. This method of verification requires the development of objective, quantifiable test procedures to verify the performance of the system with respect to the specific requirement. Objective pass/fail criteria must be established for each test. The contractor and the procuring agency shall accomplish verifications which require tests.

4.2.2 Demonstration. This method of verification requires the contractor to accomplish an objective test, with the government witnessing, during qualification testing. The demonstration shall exercise the performance capabilities in a worst case scenario. Test procedures need not be utilized during the demonstration of a specific performance capability.

4.2.3 Analysis. This method of verification is reserved for requirements which are difficult, costly, or impossible to develop an objective test procedure. Analysis is defined as the verification of a requirement through the quantitative assessment of data, equations, software architecture, tables or other substantiating technical documentation for the purposes of evaluating performance criteria.

(Additional subparagraphs may be created to identify any special test requirements for the MSS. Examples of special tests may include thermal testing, reliability testing, IOT&E. Special test requirements may also be specified in the SOW.)

4.3 Requirements Cross Reference. A requirements compliance cross reference matrix shall be developed to ensure requirement verification traceability. The requirements cross reference matrix shall be included as part of the _____ *(insert application aircraft type)* MSS Prime Item Development Specification (PIDS).

5. PREPARATION FOR DELIVERY

5.1 Pre-shipment Inspection. A pre-shipment inspection shall be accomplished prior to shipment of each segment, and of the integrated system to ensure that equipment is in an undamaged state prior to shipment.

(To reduce risk of receiving faulty equipment at a remote site, pre-shipment or acceptance tests are desirable. In general, inspections should verify equipment physical acceptability, while testing should concentrate on verifying key performance functional parameters. Additional pre-shipment inspection requirements applicable to the MSS should be specified in this paragraph.)

5.2 Preserving and Packaging. Best commercial practices shall be used to preserve and package the _____ *(insert application aircraft type)* MSS for shipment. Packaging shall be sufficient to ensure that no damage, or performance degradation, is caused by shipment to any location within the continental United States.

(The packaging criteria assumes shipment to sites within the continental United States using trailer and aircraft transportation. If the actual simulators are to be shipped overseas or by rail transportation, packaging and preservation requirements will be more extensive. Rail and overseas shipment test requirements may be required to verify post shipment operation. Specific packaging requirements and standards should be identified in this paragraph.)

5.3 Marking. Marking for shipment shall be in accordance with MIL-STD-129.

(Identify applicable MIL-STD-129 requirements.)

6. NOTES

6.1 Intended Use. The _____ *(insert application aircraft type)* MSS shall allow trainees to recognize system malfunctions, respond to abnormal indications, and execute corresponding emergency procedures. The _____ *(insert application aircraft type)* MSS shall be designed to support the following types of training:

a. Initial Crew Training: The objective of initial crew training is to graduate flight capable aircrews for the _____ *(insert application aircraft type)* aircraft.

b. Mission Qualification: The objective of mission qualification training is provide sufficient development of aircrew tactical capabilities for mission rehearsal and total mission scenarios in the _____*(insert application aircraft type)* aircraft.

c. Continuation Training: The objective of continuation training is to provide facilities for execution of tasks necessary for skill maintenance and preparation for Operational Readiness Inspections (ORI) on the _____*(insert application aircraft type)* aircraft.

d. Initial Instructor Qualification: Initial instructor qualification capability shall provide for the certification of _____*(insert application aircraft type)* aircraft instructors prior actual aircraft instructor certification

(Tailor to accurately reflect a summary of the training requirements for the intended application. Source data would be Training Analysis Studies and Instructional System Development (ISD) studies.)

6.1.1 Missions. Missions shall be recallable during the training mode, allowing specific mission initial conditions to be loaded in the MSS segments. A minimum of one predefined mission shall be provided to allow system initialization. This mission shall be referred to as "Mission Zero", and shall be defined as required to meet the basic requirements of the _____ *(insert application aircraft type)* MSS.

(Identify missions for which this MSS is intended to provide training. Generally not all missions or mission phases are significant enough to impact simulator design. The training analysis should identify critical training tasks which should be identified in this paragraph or its subparagraphs.)

6.1.1.1 Aircraft Operations. Aircraft operations, tasks and procedures, shall be simulated and performable in the _____

(insert application aircraft type) MSS to the level of fidelity and with the conditions described in the following paragraphs.

(Identify flight operations which will be required for training. Additional subparagraphs may be added if required by the application.)

6.1.1.1.1 Ground Operations. The _____ *(insert application aircraft type)* MSS shall simulate ground operations including: touch down impact, taxi, ground refueling, external electrical power application, and ground emergency procedures in accordance with the _____ *(insert application aircraft type)* design criteria.

(Identify operations such as: preflight, engine start, etc. and the specific training requirements for each operation. Levels of training fidelity should also be specified.)

6.1.1.1.2 Takeoff/Climb/Cruise. The _____ *(insert application aircraft type)* MSS shall simulate all phases of aircraft takeoff, climb, and cruise operations in accordance with the _____ *(insert application aircraft type)* design criteria.

(Specify flight operations, such as, aerial refueling, navigation, hover, etc. and the specific training requirements for each operation. Levels of training fidelity should also be specified.)

6.1.1.1.3 Approach and Landing. The _____ *(insert application aircraft type)* MSS shall simulate all phases of aircraft approach and landings including ground effects and emergency landing procedures in accordance with the _____ *(insert application aircraft type)* design criteria.

(Specify operations such as Instrument Landing System (ILS), Microwave Landing System (MLS), Vertical descent, etc. and the specific training requirements for each operation. Levels of training fidelity should also be specified.)

6.1.1.1.4 Application Specific Flight Operations. The _____ *(insert application aircraft type)* MSS shall simulate _____ *(insert application aircraft type)* aircraft specific flight operations in accordance with the requirements of the following subparagraphs.

(Subparagraphs may be added which list specific application aircraft flight operations. Examples of such operations may include: TA/TF, Nap-of-the-Earth flight, etc. The operations and training requirements that are listed in these paragraphs are usually very unique and should be identified and described to the greatest detail possible.)

6.1.1.2 Mission Specific Operations. The following mission operations, tasks and procedures shall be simulated and performable in the _____ *(insert application aircraft type)* MSS to the level of fidelity and with the conditions described.

(Specify mission operations, such as, weapons releases, missile launches, air-to-air combat, tactical considerations, etc. and the specific training requirements for each operation. Levels of training fidelity should also be specified.)

6.1.1.3 Multiple Simulator Operations. The _____ *(insert application aircraft type)* MSS shall provide an interface to allow for the interoperability/networking of the MSS to other training devices for the purpose of team and tactical training. The interconnection of the MSS to other devices shall be via the Environment segment. Team and tactical training requirements shall include:

a. Formation Flight
b. Multiple Weapon System Tactical Exercises

(Specific network training requirements should be enumerated in this paragraph. The specific network protocol should be identified.)

6.1.2 Threat. Not applicable.

6.2 Acronyms. The acronyms contained in this paragraph are unique to the _____ *(insert application aircraft type)* MSS.

(Identify acronyms which are unique to the application aircraft or simulator)

ASC	Aeronautical Systems Center
AHRS	Attitude Heading Reference System
ANSI	American National Standard Institute
C&D	Controls and Displays
DOD	Department of Defense
ECM	Electronic Countermeasures
EWE	Electronic Warfare Environment
GFP	Government Furnished Property
IDD	Interface Definition Document
IFF	Identification Friend or Foe
INS	Inertial Navigation System
I/O	Input/Output
IOS	Instructor Operator Station
MSE	Multiple Simulator Environment
MSS	Modular Simulator System
MTBCF	Mean Time Between Critical Failure
MTBF	Mean Time Between Failure
MTBM	Mean Time Between Maintenance
MTTR	Mean Time to Repair

NAVCOM	Navigation/Communication
PIDS	Prime Item Development Specification
SOW	Statement Of Work
SSS	System/Segment Specification
STP	System Test Plan
VNET	Virtual Network

6.3 MSS Glossary

(This glossary should contain a concise description of MSS unique terminology which will assist users in the interpretation of the requirements and definitions. Additional paragraphs may be added if desired to clarify a specific technical question or concept. An example might be coordinate definitions.)

ADA. A general purpose computer programming language required for mission critical systems as defined in ANSI/MIL-STD-1815A.

AUTONOMOUS. Single training system environment.

BACKDOOR. A backdoor is an interface through which a segment may communicate instead of the MSS VNET. A backdoor connection may consist of shared aircraft avionics, shared simulation databases or shared development facilities. A backdoor connection may be implemented in hardware, software or a combination of both hardware and software. A backdoor interface may not be utilized to transfer data which should be transmitted on the MSS VNET.

COMMERCIAL OFF-THE-SHELF EQUIPMENT. Commercial off-the-shelf equipment is defined as unmodified equipment (including assemblies and subassemblies), produced by an established commercial manufacturer, used for other than Government purposes, and sold in substantial quantities to the general public (parties other than the Government and affiliates of the seller) during the course of conducting normal business operations. Quantities are considered substantial if all the criteria established by FAR 15.804-3(f)(2) are met.

COMMON DATA BASE. A common data base comprises multiple copies of a single data base located in two or more segments. The common data bases must have the same logical format and content.

DISTRIBUTED PROCESSING. A processing environment consisting of a collection of computational systems capable of concurrently processing data in conjunction with a system of

communication hardware and software which provide for data transfer between computational systems.

MASS STORAGE. The capability to store data in large quantities in more cost effective manner than provided by on-line memory. Mass storage is usually accomplished via electromagnetic media.

MEMORY. The capacity to electronically store data in a media which provides access to data and programs.

MULTIPLE SIMULATOR ENVIRONMENT. A simulation environment involving networking of simulators in single training exercise.

SEGMENT. A segment is an autonomous processing system which performs designated functions and communicates with other processing systems over the VNET.

SEGMENT MODE: Allows individual segments to be independently initialized to a stable state in an autonomous environment.

NATURAL ENVIRONMENT. Geographic and atmospheric conditions and phenomenon including lighting and magnetic field variations in which the ownship operates.

PROCESSING CAPACITY. The total processing time used by each processor during any one of the periods of time available to that processor, corresponding to the highest iteration rate being used, in the worst case path, which is logically possible during any program solution.

PROCESSING SUBSYSTEM. Any combination of processors, support boards, and peripheral devices use together to provide a complete computational unit. The combination of processors may be either tightly or loosely coupled.

PROCESSING SYSTEM. The sum of all the processing subsystems which comprise all processing equipment for the system.

PROCESSOR. Any computing unit used to execute software programs and handle data. The definition includes microprocessors, microcomputers, single-board computers, minicomputers, super minicomputers, supercomputers, Central Processing Units (CPU), Internal Processing Units (IPU) and Auxiliary Processing Units (APU).

PROTOCOL. Protocol is the set of rules and conventions by which data is transferred between segments and the VNET.

REAL-TIME SIMULATION. Real-time simulation is a sequence of operations such that the ratio of the elapsed time between

two simulated events A and B, in the simulated system, and the elapsed time between the corresponding two real events, A prime and B prime, in the physical system is unity. Synchronization and interaction with man or machines is implied.

REPOSITION. An action to translate the ownship to a new stable state from which no uninitiated responses occur upon restarting the simulation

Reset Mode: Allows recovery, without rebooting the entire MSS, from circumstances where a segment is not operating correctly. An operational software reload clears segment memory of any abnormalities or errors which have appeared in the segment. An example of its use is when the trainee has entered a series of erroneous data (into the Nav segment for example) causing that function to be incapable of effective training. Reset would allow the capability to recover that function and continue training.

SERVICE PROCESSING. The processing of information by a segment in support of one or more other segments where the processing may not be required by the processing segment but is performed as a direct service for other segments. Emitter occulting is an example of such processing which is performed by the Visual or Radar segments as a service to the Electronic Warfare or Navigation segments.

SHARED DATA BASE. A shared data base is a data base which is comprised of required data used by two or more segments and located at a single location. See also COMMON DATA BASE.

System Mode. The "Ready" or "Standby" condition for each segment. Individual segments, or the entire simulator, can then be commanded to one of the remaining modes or states in accordance with the defined interface.

TACTICAL ENVIRONMENT. A collection of man made, initiated, or controlled elements that are external to the ownship, and not part of the natural environment.

Training Mode. This mode enables the MSS to accomplish all real time crew training activities. When the segment enters the training mode, it shall be in a wait state and shall not accomplish any operations until directed to do so by the IOS segment.

VIRTUAL NETWORK (VNET). The medium for carrying data/signals to and from the various segments in the modular simulator system. The primary and central component of the communications network.

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REVISIONS

LTR	DESCRIPTION	DATE	APPROVAL
A	BMAC-STS-86-303-1 Total revision required to incorporate changes required by testing/validation efforts and Government comments.	91/01/17	S. Clem Prepared By
		91/01/17	Checked By
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REVISIONS			
LTR	DESCRIPTION	DATE	APPROVAL
C	CCP HSV-H91-008 Total revision required to incorporate Government comments on document.	91-09-26 91.09.26 91/09/26 91-09-26 91-12-08	K Kelly Prepared By Checked By Dsg. Qual. Supervised By Approved By
D	CCP HSV-H91-017 This specification volume has been totally revised to: 1. Change the format to comply with DI-CMAN-80008A. 2. Incorporate the tailoring instructions into the body of the text. The incorporation of tailoring instructions into each specification volume has caused a change in the number of specification volumes from fourteen to thirteen. Prior to this change, all tailoring instructions were provided in Volume XIII and Volume XIV contained the Tactical and Natural Environment segment specification. The content of Volume XIII has been integrated into the other specification volumes. The change is summarized as follows: Volume / IS / WAS I through XII — Titles for these volumes are unchanged XIII — Environment — Tailoring Instructions XIV — "Deleted" — Tactical and Natural Environment	93-08-23 93-08-23 93-08-23 93-08-24	PREPARED CHECKED SUPERVISED APPROVED

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